

WHAT IS CLAIMED IS:

1. A molecule assigning a genotype to a phenotype, which comprises a nucleic acid portion having a nucleotide sequence reflecting the genotype, and a protein portion
5 comprising a protein involved in exhibition of the phenotype, the nucleic acid portion and the protein portion being directly bound by a chemical bond.
2. The assigning molecule according to claim 1, wherein a 3'-terminal end of the nucleic acid portion and a C-
10 terminal end of the protein portion are bonded with a covalent bond.
3. The assigning molecule according to claim 1 or 2, wherein a 3'-terminal end of the nucleic acid portion covalently bonded to a C-terminal end of the protein portion
15 is puromycin.
4. The assigning molecule according to any one of claims 1 to 3, wherein the nucleic acid portion comprises a gene encoding a protein, and the protein portion is a translation product of the gene of the nucleic acid portion.
- 20 5. The assigning molecule according to claim 4, wherein the nucleic acid portion comprises a gene composed of RNA, and a suppressor tRNA bonded to the gene through a spacer.
6. The assigning molecule according to claim 5, wherein the suppressor tRNA comprises an anticodon corresponding
25 to a termination codon of the gene.
7. The assigning molecule according to claim 4, wherein the nucleic acid portion comprises a gene composed of RNA,

and a spacer composed of DNA and RNA.

8. The assigning molecule according to claim 4, wherein the nucleic acid portion comprises a gene composed of RNA, and a spacer composed of DNA and polyethylene glycol.

5 9. The assigning molecule according to claim 4, wherein the nucleic acid portion comprises a gene composed of RNA, and a spacer composed of a double-stranded DNA.

10 10. The assigning molecule according to claim 4, wherein the nucleic acid portion comprises a gene composed of RNA, and a spacer composed of a double strand of RNA and a short chain peptide nucleic acid (PNA) or DNA.

11. The assigning molecule according to claim 4, wherein the nucleic acid portion comprises a gene composed of DNA, and a spacer composed of DNA and RNA.

15 12. A method for constructing the assigning molecule as defined in claim 5, which comprises (a) bonding a DNA comprising a sequence corresponding to a suppressor tRNA, to a 3'-terminal end of a DNA containing a gene through a spacer, (b) transcribing the obtained DNA bonded product
20 into RNA, (c) bonding, to a 3'-terminal end of the obtained RNA, a nucleoside or a substance having a chemical structure analogous to that of a nucleoside, which can be covalently bound to an amino acid or a substance having a chemical structure analogous to that of an amino acid, and (d)
25 performing protein synthesis in a cell-free protein synthesis system using the obtained bonded product as mRNA to bond a nucleic acid portion containing the gene to a

translation product of the gene.

13. A method for constructing the assigning molecule as defined in claim 7, which comprises (a) preparing a DNA containing a gene which has no termination codon, (b) 5 transcribing the prepared DNA into RNA, (c) bonding a chimeric spacer composed of DNA and RNA to a 3'-terminal end of the obtained RNA, (d) bonding, to a 3'-terminal end of the obtained bonded product, a nucleoside or a substance having a chemical structure analogous to that of a nucleoside, 10 which can be covalently bound to an amino acid or a substance having a chemical structure analogous to that of an amino acid, and (e) performing protein synthesis in a cell-free protein synthesis system using the obtained bonded product as mRNA to bond a nucleic acid portion containing the gene 15 to a translation product of the gene.

14. The construction method according to claim 12 or 13, wherein the nucleoside or the substance having the chemical structure analogous to that of the nucleoside is puromycin.

15. A method for constructing the assigning molecule as 20 defined in claim 8, which comprises (a) preparing a DNA containing a gene which has no termination codon, (b) transcribing the prepared DNA into RNA, (c) bonding a chimeric spacer composed of DNA and polyethylene glycol to a 3'-terminal end of the obtained RNA, (d) bonding, to a 25 3'-terminal end of the obtained bonded product, a nucleoside or a substance having a chemical structure analogous to that of a nucleoside, which can be covalently bound to an amino

acid or a substance having a chemical structure analogous to that of an amino acid, and (e) performing protein synthesis in a cell-free protein synthesis system using the obtained bonded product as mRNA to bond a nucleic acid
5 portion containing the gene to a translation product of the gene.

16. A method for constructing the assigning molecule as defined in claim 9, which comprises (a) preparing a DNA containing a gene which has no termination codon, (b)
10 transcribing the prepared DNA into RNA, (c) bonding a spacer composed of double-stranded DNA to a 3'-terminal end of the obtained RNA, (d) bonding, to a 3'-terminal end of the obtained bonded product, a nucleoside or a substance having a chemical structure analogous to that of a nucleoside, which
15 can be covalently bound to an amino acid or a substance having a chemical structure analogous to that of an amino acid, and (e) performing protein synthesis in a cell-free protein synthesis system using the obtained bonded product as mRNA to bond a nucleic acid portion containing the gene to a
20 translation product of the gene.

17. A method for constructing the assigning molecule as defined in claim 10, which comprises (a) preparing a DNA containing a gene which has no termination codon, and a nucleotide sequence of a spacer, (b) transcribing the
25 prepared DNA into RNA, (c) bonding, to a 3'-terminal end of the obtained RNA, a nucleoside or a substance having a chemical structure analogous to that of a nucleoside, which

- can be covalently bound to an amino acid or a substance having a chemical structure analogous to that of an amino acid,
- (d) adding a short chain PNA or DNA to a 3'-terminal end side portion of the gene in the obtained RNA bonded product
- 5 to form a double-stranded chain, and (e) performing protein synthesis in a cell-free protein synthesis system using the obtained bonded product as mRNA to bond a nucleic acid portion containing the gene to a translation product of the gene.
- 10 18. A method for protein evolution simulation, which comprises a construction step for constructing assigning molecules from a DNA containing a gene by the construction method as defined in any one of claims 12, 13, 15, 16 and
- 15 17, a selection step for selecting the assigning molecules obtained in the construction step, a mutation introduction step for introducing a mutation into a gene portion of an assigning molecule selected in the selection step, and an amplification step for amplifying the gene portion obtained in the mutation introduction step.
- 20 19. The method for protein evolution simulation according to claim 18, wherein the construction step, the selection step, the mutation introduction step and the amplification step are repeatedly performed by providing the DNA obtained in the amplification step to the construction step.
- 25 20. A method for assaying protein/protein or protein/nucleic acid intermolecular action, which comprises a construction step for constructing assigning

molecules by the construction method of any one as defined in claims 12, 13, 15, 16 and 17, and an assay step for examining intermolecular action of the assigning molecules obtained in the construction step with another protein or nucleic acid.

21. An apparatus for performing the method for evolution simulation as defined in claim 18 or 19, which comprises a means for constructing assigning molecules, said means comprising a first bonding means for bonding a DNA comprising a sequence corresponding to a suppressor tRNA to a 3'-terminal end of a DNA containing a gene through a spacer, a transcription means for transcribing the DNA bonded product obtained by the first bonding means into RNA, a second bonding means for bonding, to a 3'-terminal end of the RNA obtained by the transcription means, a nucleoside or a substance having a chemical structure analogous to that of a nucleoside, which can be covalently bound to an amino acid or a substance having a chemical structure analogous to that of an amino acid, and a third bonding means for performing protein synthesis in a cell-free protein synthesis system using the bonded product obtained by the second bonding means as mRNA to bond a nucleic acid portion containing the gene to a translation product of the gene, or a means for constructing assigning molecules, said means comprising a transcription means for transcribing a DNA containing a gene into RNA, a first bonding means for bonding a chimeric spacer composed of DNA and RNA, a chimeric spacer

composed of DNA and polyethylene glycol, a double-stranded spacer composed of DNA, or a double-stranded spacer composed of RNA and PNA or DNA to a 3'-terminal end of the RNA obtained by the transcription means, a second bonding means for

5 bonding, to a 3'-terminal end of the RNA-spacer bonded product obtained by the first bonding means, a nucleoside or a substance having a chemical structure analogous to that of a nucleoside, which can be covalently bound to an amino acid or a substance having a chemical structure analogous

10 to that of an amino acid, and a third bonding means for performing protein synthesis in a cell-free protein synthesis system using the bonded product obtained by the second bonding means as mRNA to bond a nucleic acid portion containing the gene to a translation product of the gene;

15 a selection means for selecting the constructed assigning molecules; a mutation introduction means for introducing a mutation into a gene portion of an assigning molecule selected; and an amplification means for amplifying the gene portion to which the mutation is introduced.